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RESEARCH ARTICLE OPEN ACCESS

Design Calculations and Selection for Power Train of High Utility Pedelec (Battery and BMS)

Om P. Rathod[1], Ajay S. Sonwane[2], Vivek V. Savant[3], Rushikesh A. Valvi[4], Prof. Prashant Mahajan[5]

[1, 2, 3, 4, 5] Dept of Electrical Engineering

[1, 2, 3, 4, 5] All India Shri Shivaji Memorial Society's Institute Of Information Technology, Pune, Tal. Pune, Maharashtra 411001.

Abstract— *With the continuously progressing Human civilization the environmental hazards are also increasing simultaneously. Prime one among them is the global warming caused by pollution from fossil fuel powered IC engine vehicles. Now this burning of fossil fuel also causes emission of toxic gases directly fatal to animals leading to respiratory problems. The singular obvious solution to this problem is emission free battery operates electric vehicles. Now public transport such has trains and buses have already been electrified to a huge extent but private transport still remains a far cry from reality due to size and operating range constraints. Now the most important part in any electric vehicle is the motor and battery. Motors have already been revolutionized since the entry of BLDC motors now remains the aspect of battery since it deals greatly with the vehicle's operating range and ease of use. This project highlights the various latest optimum design considerations to construct a better battery. For this, the case of an electric bicycle is taken and procedure to make a battery pack for that particular operating range and power rating is shown.*

Keywords — Electric Vehicle, Pedelec, Li-ion Battery.

I. INTRODUCTION

Electric bicycles are bicycles that have an electric motor and batteries that power the bicycle and assist with pedaling. An electric bicycle is a hybrid of electric and pedal power. Electric bicycles are not motor bikes. They are usually limited by law to a specific power so that they still qualify as bicycles and are exempt from registration fees, insurance, needing a driving license, and the department of safety regulations.

The specifications that electric bicycles must meet to be exempt from motor vehicleregistration vary from country to country and state to state. In Europe, the current limitis 250W maximum continuous power and 40 kg/88 lb maximum weight with no limiton peak power. In the United States, the limits vary from state to state, with somestates allowing 750 W and some not allowing electric bicycles at all. In the West, electric bicycles are new technology, and most people don't know anything aboutthem. In the Far East, however, electric bicycles are big business. In China, electricbicycles outnumber cars by four to one.You may find that your electric bicycle draws a lot of attention. When parked, youwill see people stare and try and figure out what all the strange-looking bits are for. Ifyou are seen with an electric bicycle, you might get asked lots of questions byinquisitive people.

II.LITERATURE REVIEW

E-bikes, also known as electric bicycles, power bikes, pedelecs, or booster bikes, are bicycles with an integrated electric motor that does not exceed 750 watts of power.

• Class 1: Low-speed pedal-assisted electric bicycle equipped with a motor that provides assistance only when the rider is pedaling and that ceases to provide assistance when thee-bike reaches 20 mph.

• Class 2: Low-speed throttle-assisted electric bicycle equipped with a throttle-actuatedmotor that ceases to provide assistance when the e-bike reaches 20 mph.

• Class 3: Pedal-assisted electric bicycle equipped with a motor that provides assistance only when the rider is pedaling and that ceases to provide assistance when the e-bike reaches 28 mph. Note: class 3 e-bikes are prohibited on all open space trails.

III. BLOCK DIAGRAM

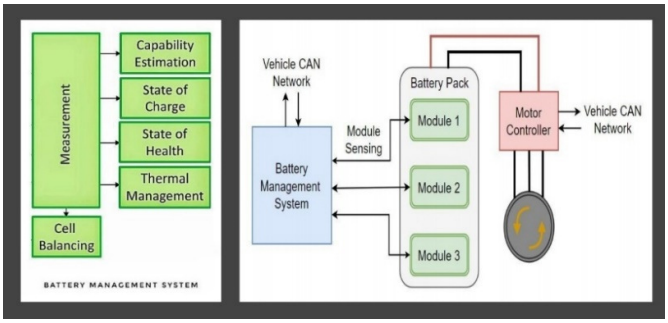


Fig. Block Diagram of BMS

IV. CALCULATIONS

1. Finding out the current consumed by the 250 W Hub motor to run,

Power = voltage X current

250 / 36 = current

Current = 6.94 A

So the current consumed by the Hub motor to run is approx. 7 Amp.

2. Finding out the watt hour of the Battery.

To run the 250 W Hub motor for 1 hour

Multiplying (250W X 1 hour) = 250 Watt hour.

Taking efficiency of 80% for battery.

i.e 250 / 0.8 = 312.5 Watt Hour

So to run the 250 W Hub motor for 1 hour the Watt hour of the Battery is 312.5 Watt Hour

3. Converting watt hour of battery into Ampere hour of the Battery.

Power = Voltage X Current

Also Watt hour = Voltage X Ampere Hour

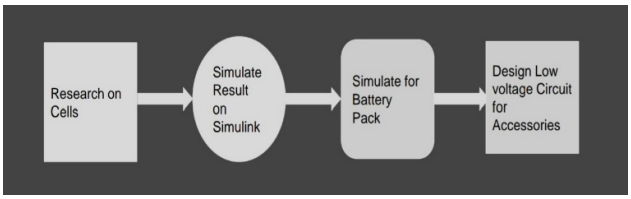
312.5 = 36 X Ah

Ampere Hour = 8.66 Ah

Therefore to run the 250 W motor for 1hour, 36 V 8.66 Ah Lithium-ion Battery is needed.

V. METHODOLOGY

As we are going to design the affordable battery pack and accessories of Electric Bicycle it is necessary to know about the different types of cells available in the market. So the research on different types of cells is done. After this the available data of different cells is checked by simulating it on simulink.
Then using the simulink software the battery pack is simulated using appropriate cells. The performance of the battery is also tested by simulating it on the software. And finallythe low voltage circuit for accessories is simulated.



VI. EXPECTED RESULTS

i. Battery should run till calculated miles/Time.
ii. It should not get overheated.
iii. Display should be able to show battery percentage, acceleration, speed and location.

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